Establishment of a Integrated Natural Resource Management System (INRMS) for South Africa:

Observations on rangelands condition & productivity

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Outline

• Background to South Africa

• About INRMS for South Africa

• Draft System Components and Outputs

• Existing R&A Development Projects

• Identification of areas for close monitoring
SA - Background

- 9 Provinces
- Home to 53+ million people
- Varied climate regions
- Mostly unimodal rainfall system
- Several Terrestrial Biomes (Grassland, Savanna, Succulent Karoo, Nama Karoo, Forest, Fynbos, Thicket, Desert)
- Varied range & pasture systems
- Both rain fed & irrigation pasture systems in South Africa.
- Main Livestock types include cattle, goats, sheep, and abundant wildlife
- Prone to recurrent floods and droughts.
  - Other main challenges include bush fires, bush encroachment and thickening, deforestation, loss of biodiversity.
Our core business

- Data reception
- Archive
- Data processing
- Data dissemination
- Geo-information Products & Applications

Earth Observation Directorate

- Sensor Portfolio Management & Data reception
- Data Archiving, Processing & Dissemination
- Geo-information Products & Applications

Contribute to
- greater utilisation of earth observation in addressing day-to-day societal problems & needs
- better planning & decision making; performance monitoring; environmental & resource management; disaster management; national security & health
About a INRMS for SA

• Instigated by Inter-Departmental sub Working Group on Natural Resource Management (inventories & assessments)

• **Aim:** to provide planners, policy makers and land managers with easy access to information necessary for revitalizing natural resource monitoring and assessment, enhance food security and promote strategic objective of the National Development Plan (NDP) and the New Growth Path (NGP) Framework.
key activities include:

- Facilitate development of networks for timely collection of information for early warning,
- Vulnerability assessments,
- Production assessments,
- Establishment of integrated database on natural rangeland resources and inventory

Expected outcomes

- an improved capacity to manage risk and improve production at national scale;
- improved capacity to manage variability in production.
- improved forecasts of pasture and rangelands productivity variability.
The Challenge

• Which primary observations are required for NR monitoring?
• Who collects, stores and makes these available?
• Conversion of primary observations to 1st /2nd order products
• Systems to make products' accessible.
• Systems to compile reports

Scope of current work

• A review of changes in status and threatening processes
• A review of rangeland monitoring programs and their real and potential contribution to resource monitoring (Government's Land Care Project).
• A review of information gathered from existing monitoring programs.
• Define the approach to a national scale monitoring of rangeland/pasture resources: a review of international experience.
A straw dog for discussion

30 Highest-Ranked Earth Observations by Cross-SBA Score
The philosophy and design of a NR Monitoring Framework for SA

- Primary observations
- Secondary derived variables/derivatives
- Monitoring products
- Organizational/institutional mandates
- Various monitoring systems to meet mandate
- Each system requires different observations/variables to meet the mandate but commonality exists
Draft System Components and Outputs

Veld Production MS: various components of change
Amount biomass grazed/removed by, e.g. hay, thatch, fire..

Invader vegetation MS

Soil Erosion MS

Veld degradation MS

Secondary / Derived variables
ET, fPAR, Above ground C/biomass, etc

Algorithms / Models

Primary Products
Rainfall, NDVI, Soil Moisture, Land cover, etc

Algorithms

Primary Observations
Images, In – situ instruments, field forms
Approach

- Identify key rangeland areas for monitoring
  - analysis of historical yield and production information
  - livelihood analysis profiles

- Information from National/international Early Warning Systems
  - Climate/weather outlooks, rainfall performance
  - Range- and pasture-land condition
  - Livestock numbers and health
  - Production estimates.
Approach

- Hydrological information
  - water balance modeling for
  - water requirements satisfaction Index

- Use convergence of evidence to analyze and arrive at conclusions on the state of rangeland

- Ensure interoperability with relevant regional and international systems, e.g. GEO’s GEOGLAM

- Identify key areas for close monitoring, i.e. transforming grasslands/savanna biome
Some R&A
Developments on:  RANGELANDS
Environmental change in South Africa: Bush encroachment

Figure 3.10 Boer War trenches photographed by H. Exton just after the battle of Magersfontein near Kimberley in 1899 (a) and by Hoffman and Ward in 2003 (b).

Figure 3.16 Magersfontein battlefield. (a) Taken just before the battle on 11 December 1899. (b) The same photograph as (a) taken in 2001, heavily encroached by *Acacia tortilis*. Note that the Boer soldiers would not have been able to annihilate the British soldiers of the elite Black Watch Regiment had there been trees present. [David Ward]
Mapping seasonal profiles of C3/C4 grass/forb functional types in South Africa
An evaluation of Landsat multi-temporal scenes for mapping seasonal profiles of functional types in Southern Africa
Initial results

A decrease in abundance of C3 grasses/forbs in the Drakensberg mountain range, South Africa

Estimate of C3 grass/forbs distribution
June 1993

Estimate of C3 grass/forbs distribution
June 2015
Estimate of C3 grass/forbs distribution
June 1993

Initial results

Estimate of C3 grass/forbs distribution
June 2015
Estimate of C3 grass/forbs distribution

Initial results

June 1993

Estimate of C3 grass/forbs distribution

June 2015
Biomass Estimation

Ramoelo et al. 2015
Integration of remote sensing and conventional models for modeling grazing/browsing capacity in southern African savannas

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Grazing Capacity
ha/AU
Low : 20.11
High : 2.25

Grazing Capacity
ha/AU
Low : 50.28
High : 2.29

Illustration of measurements collected for BECVOL calculations
Identified Areas of Need/Concern

- **Rangeland production information**
  - Rainfall amount and patterns
  - Crop Area Measurement
  - Production estimate
- **Environmental risk monitoring**
  - Drought/flood
  - Bush fires
  - Bush encroachment
  - Plant invasion
- **Natural Resources Management**
  - Water bodies monitoring
  - Soil types and Fertility
  - Wetland status
- **Land management information**
  - Deforestation/afforestation
  - Alien Species Invasion
  - Grazing Capacity
  - Seasonal biomass monitoring
  - Classification of potential land uses
  - Demarcation of range land
Work toward solutions to issues identified as priorities

- An assessment of existing natural resource related data/information/systems
- Identification of core data custodians for natural resource related data
  - detail break down and an analysis
- Development of user specifications for a natural resource monitoring system in line with the above
- Look for collaboration points with GEO/SA-GEO partners outside of Natural Resources:
  - Promote the integration, coordination and collaboration on EO-based NRM across multi-platform and multi-disciplinary network for South Africa.
  - Develop and support Natural Resources management best practices and encourage standards adoption.
Identification of areas for close monitoring
Identification of areas for close monitoring
Potential Monitoring sites to contribute to GEOGLAM RAPP

Legend
- Water seasonal
- Water permanent
- Wetlands
- Indigenous Forest
- Thicket / Dense bush
- Woodland / Open bush
- Grassland
- Shrubland fynbos
- Low shrubland
- Cultivated comm fields (high)
- Cultivated comm fields (med)
- Cultivated comm fields (low)
- Cultivated comm pivots (high)
- Cultivated comm pivots (med)
- Cultivated comm pivots (low)
- Cultivated orchards (high)
- Cultivated orchards (med)
- Cultivated orchards (low)
- Cultivated permanent pineapple
- Cultivated subsistence (high)
- Cultivated subsistence (med)
- Cultivated subsistence (low)
- Cultivated cane pivot - crop
- Cultivated cane pivot - fallow
- Cultivated cane commercial - crop
- Cultivated cane commercial - fallow
- Cultivated cane emerging - crop
- Cultivated cane emerging - fallow
- Plantations / Woodlots mature
- Plantation / Woodlots young
- Plantation / Woodlots clearfelled
- Mines 1 bare
- Mines 2 semi-bare
- Mines water seasonal
- Mines water permanent
- Mine buildings
- Erosion (donga)
- Bare none vegetated
- Urban commercial
- Urban industrial
- Urban informal (dense trees / bush)
- Urban informal (open trees / bush)
- Urban informal (low veg / grass)
- Urban informal (bare)
- Urban residential (dense trees / bush)
- Urban residential (open trees / bush)
- Urban residential (low veg / grass)
- Urban residential (bare)
- Urban smallholding (dense trees / bush)
- Urban smallholding (open trees / bush)
- Urban smallholding (low veg / grass)
- Urban smallholding (bare)
- Urban sports and golf (dense trees / bush)
- Urban sports and golf (open trees / bush)
- Urban sports and golf (low veg / grass)
- Urban sports and golf (bare)
- Urban school and sports ground
- Urban sports and golf (dense trees / bush)
- Urban sports and golf (open trees / bush)
- Urban sports and golf (low veg / grass)
- Urban sports and golf (bare)
- Urban township (dense trees / bush)
- Urban township (open trees / bush)
- Urban township (low veg / grass)
- Urban township (bare)
- Urban village (dense trees / bush)
- Urban village (open trees / bush)
- Urban village (low veg / grass)
- Urban village (bare)
- Urban built-up (dense trees / bush)
- Urban built-up (open trees / bush)
- Urban built-up (low veg / grass)
- Urban built-up (bare)

K2C Site
LC8_168_77_NDVI

KZN Drakensberg Site
LC8_169_80_NDVI

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Thank you